NUTRITIONAL AND TOXICOLOGICAL STUDIES WITH ARCELIN-CONTAINING BEAN GENOTYPES

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Wild bean genotypes with high levels of resistance to the bruchids *Zabrotes subfasciatus* (Boheman) and *Acanthoscelides obtectus* (Say) were identified by Schoonhoven et al (1983). Resistance to bruchids in these genotypes is due to antibiosis (Cardona et al, 1989). Arcelin (Arc), a novel seed protein, was found to be the factor responsible for resistance to *Z. subfasciatus* (Osborn et al, 1988) while the biochemical basis for resistance to *A. obtectus* remains to be elucidated.

Arcelin can be transferred into bean cultivars by means of backcrossing and other breeding methods (Harmsen et al, 1988; Osborn et al, 1988; Cardona et al, 1990). Advanced lines with high levels of resistance to *Z. subfasciatus* have been produced. Before releasing these lines to national programs in Africa and Latin America, it was considered necessary to run a series of tests on possible toxicological effects of the protein on mammals. Following is a summary of available information on the safety of arcelin.

Initial tests were conducted in 1986 by Drs. Hosfield at Michigan State University and Bressani at INCAP (Instituto de Nutrición de Centro America y Panama) in Guatemala. Hosfield (unpublished report) conducted rat growth studies with diets comparing lines SG3 (Arc^+) and SG3 (Arc^-). He concluded that arcelin protein in cooked beans was not toxic to rats. Bressani (unpublished report) prepared diets for rats with wild accessions G 12953 (Arc^+), G 12952 (Arc^+), G 12861 (Arc^-) and G 10000 (Arc^-). Again, no differences were found among diets for nutritional value.

Tests have also been conducted using RAZ 2, a *Zabrotes*-resistant line developed at CIAT. Bressani (1990, unpublished report) compared the effect of feeding Winstar rats with diets prepared with RAZ 2 and with EMP 175 (the susceptible Arc^- recurrent parent from which RAZ 2 was derived). Net Protein Ratios, Food Efficiency Ratios, and weight gains were better with RAZ 2. Even at 20% protein in the diet, RAZ 2 was of better quality than EMP 175, and no toxic effects on the rats were observed. Pusztai (1990, unpublished report) followed the Net Protein Utilization method to compare RAZ 2 and EMP 175. In the raw, unprocessed state, RAZ 2 was clearly superior to EMP 175. The new resistant line was about 1.6 times more digestible than the parental line and was utilized more than twice as efficiently as the susceptible cultivar. After cooking, most of these differences disappeared and the recurrent parent became slightly superior in nutritional value. Pusztai concluded that "this new bean variety is not inherently toxic and can be consumed even in the raw or not properly processed state without undue detrimental effects on growth and health".

At CIAT (1987-1990), a series of tests have been conducted using albine Swiss mice. Preliminary tests comparing the resistant (Arc^+) accession G 12891 with the susceptible (Arc^-) cultivar 'Calima' did not reveal significant differences between diets. No toxic effects were apparent in mice fed the resistant accession. When increasing levels of protein (10, 20,

30%) were incorporated in the diet, mice fed G 12954 (Arc^+) gained as much weight and showed the same Protein Efficiency Ratios as those fed 'Calima' at a given protein level. When blood samples were analyzed for hemoglobin, glucose, urea, total protein, albumin, uric acid, and creatin no differences between diets were detected. Liver and kidney weights did not differ either.

The available information on the safety of arcelin indicates that, when properly cooked, arcelin- containing beans do not seem to have deleterous effects on mammals.

References

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